ECS Inaugurates Symposium on the Chemistry of Vapor-Phase Materials Synthesis

The Electrochemical Society is inaugurating a symposium entitled "Fundamental Gas-Phase and Surface Chemistry of Vapor-Phase Materials Synthesis," the first of which will be held at the Society's Fall Meeting November 1–6, 1998 in Boston. The Symposium, chaired by T.J. Mountziaris (State University of New York—Buffalo), is endorsed by both the Materials Research Society and EUROCVD. The venue for the conference is the Sheraton Boston Hotel and Towers. The deadline for submission of abstracts is **June 1, 1998.**

This Symposium will address the state-of-the-art in vapor-phase synthesis and processing of materials with emphasis on gas-phase and surface chemistry and its effects on growth/etching rates and material properties. Topics will include chemical vapor deposition (such as thermal, rapid thermal, plasma-assisted, photon-assisted, ion-assisted, and particle-assisted), vapor-phase etching, molecular- and chemical-beam epitaxy, and aerosol synthesis. Both oral and poster presentations will be included.

Papers are sought in the following areas: kinetics of gas-phase and surface reactions underlying the vapor-phase processing of materials, including fundamental measurements of kinetic constants as well as *in situ* probing during film growth/etching and particle synthesis; surface and interfacial chemistry during heteroepitaxy and selective epitaxy; new precursors and growth/etching chemistries; quantum-chemistry calculations for predicting thermochemistry, mechanisms, and rate parameters; *in situ* monitoring and control of materials composition, morphology, electrical, and optical properties; fundamentals and *in situ* monitoring of gas-to-particle conversion; particle formation issues during CVD; and models describing the kinetics and transport phenomena that occur during vapor-phase materials processing, with special emphasis on hierarchical models leading from the molecular to the mesoscopic level (properties) and from the mesoscopic to the macroscopic level (processes).

Invited speakers include R.W. Carr (Minnesota University) whose talk is entitled, "Gas Phase Chemistry in Chemical Vapor Deposition"; S.L. Girshick (Minnesota University), "Numerical Model of Gas-Phase Nucleation and Particle Growth During CVD of Silicon"; J.R. Creighton (Sandia National Laboratories), "Surface Stoichiometry, Structure, and Kinetics of GaAs MOCVD"; M.S. Gordon (Iowa State University), "Potential Energy Surfaces: From the Gas Phase to Surface Chemistry"; R.G. Gordon (Harvard University), "Liquid Precursors for CVD of Metals and Oxides"; R.F. Hicks (University of California—Los Angeles), "Atomic Structure of Compound Semiconductor Surfaces in the MOVPE Environment"; M.L. Hitchman (University of Strathclyde), "Analysis of CVD Processes"; D. Maroudas (UC—Santa Barbara), "Atomic-Scale Modeling of Plasma-Surface Interactions in the PECVD of Silicon"; and P.R. Westmoreland (University of Massachusetts), "Experimental Gas-Phase Kinetics for Parallel-Plate PECVD."

For instructions regarding electronic submission of abstracts and to view the call for papers, use the meeting website at http://www.electrochem.org/meetings/194/meet.html, or contact The Electrochemical Society, 10 South Main Street, Pennington, NJ 08534-2896, USA (e-mail: ecs@electrochem.org) to receive an abstract submission form. Inquiries regarding the symposium may be sent by e-mail to either T.J. Mountziaris (tjm@eng. buffalo.edu) or M.D. Allendorf (mdallen@ sandia.gov).

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Advanced Catalysts and Nanostructured Materials: Modern Synthetic Methods

W.R. Moser, Editor
(Academic Press, San Diego, 1996)
xxvi + 592 pages, $85.00
ISBN 0-12-508460-9

Like the proverbial parson's egg, this timely book is good in parts; in a few other parts, however, it is disappointing. As the editor rightly said, "Several disciplines of modern materials sciences are essential to the discovery, development, and improvement of advanced catalysts for chemical, petrochemical, environmental, energy commodity and fine chemical processes." Many of the catalysts in current commercial use are examples of nanostructural materials. Not only is the crystallite size often as little as 2–5 nm, but frequently clusters (of platinum in particular) consisting of less than 20 atoms, mounted on an oxide support, are the quintessential features of the active catalyst.

Solid catalysts are perennially relevant and unendingly fascinating, as we are reminded afresh on reading the admirable chapter on sintering-resistant honeycomb supports by Felthouse et al. who recall that an enterprising Englishman, Peregrine Philips, discovered how to manufacture sulfuric acid from supported platinum catalysts in 1831.

Members of the catalytic cognoscenti, as well as novitiates, will benefit from the worthwhile introduction to many novel preparative methods given in this multi-authored text: hydrodynamic cavitation as a means of producing phase-pure nanocrystals (chap. 12); rapid thermal decomposition of precursors in solution (synonymous with the flow-through hydrothermal method) (chap. 11); the exemplary summaries by Clearfield of the preparation and the catalytic properties of pillared clays, and by Soled et al. (chap. 16) of the production of the evermore important bulk and supported heteropolyacid salts; aerogel synthesis methods (chaps. 2 and 6B); the elegant account of surfactant-stabilized nanoscale colloidal metal catalysts and their precursors (chap. 7); the aerosol (which is also termed spray pyrolysis and mist decomposition) method of preparing advanced catalytic material (chaps. 19, 21, and 22); and the gas-phase synthesis of nonstoichiometric nanocrystals by Ying and Tschöpe are all noteworthy.

The opening chapter (by Mobil scientists Vartuli et al.) appropriately focuses on one of the most exciting developments in catalysis and surface science in recent years: the designed synthesis of mesoporous molecular sieve systems. My only disappointment about this chapter is that far too little attention is given to postsynthesis functionalization of the pore walls, which is undoubtedly one of the crucial growth areas in catalysis science and technology in recent years. (For an up-to-date summary of this important area, consult the succinct summaries of Maschmeyer and Zhao et al. in *Current Opinion in Solid State and Materials Science* **3** [1998] 71, 111.)

Chapter 13, devoted to nanocrystalline zeolites, disappointed me most. The only

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zeolite it describes is zeolite L which in its as-prepared form has almost a negligible role in industrial or laboratory catalysis. Also, this chapter's emphases are misplaced. We are told that "zeolite nanocrystals are ideally suited for such (i.e., electron microscopy) studies," (p. 309). While this is true, the converse is more appropriate. We are entitled to expect illumination and insight about zeolitic catalysts from the application of electron microscopy—a technique well-suited for such work as was demonstrated in the early 1980s. This chapter is discursive; and, in addition, the quality of the published micrographs (as in many other chapters regrettably) leaves much to be desired.

Another shortcoming of the book is that it does not provide enough quantitative information about catalytic performance (activity, selectivity, and longevity) of the nanostructural materials in comparison with the space devoted to their preparation and (*ex situ*) characterization. Moreover, *in situ* methods of probing catalysts is hardly mentioned. This, after all, is one of the few approaches that can help elucidate the mechanisms of catalytic conversion. If we know the mechanism of catalytic reaction, it is easier to design superior catalysts.

All in all, however, this book is to be welcomed. I will certainly advise my younger colleagues and others to consult the majority of this collection.

Reviewer: *Sir John Meurig Thomas is Master of Peterhouse, University of Cambridge and professor of chemistry at, and formerly director of, the Royal Institution of Great Britain.*

Transmission Electron Microscopy: A Textbook for Materials Science

David B. Williams and C. Barry Carter
(Plenum Press, New York, 1996)
xxvii + 729 pages, 600 illustrations, $55.00
ISBN 0-30645247-2 (Hardbound)
ISBN 0-30645324-X (Paperback)

David B. Williams and C. Barry Carter have spent several years putting together and painstakingly organizing the variety of topics collected for this monumental, exhaustive textbook on transmission electron microscopy (TEM). While students are the targeted audience, materials scientists with needs for, but little experience in, TEM are not excluded. Obviously, DBW and CBC's achievement was worth it.

While a number of books and textbooks on TEM are available, this distinct text combines (1) practical information which one can acquire only by experience; (2) elements needed to apprehend the physical origin of any phenomenon that takes place in and occasionally out of the microscope column; and most importantly (3) implications these may have on the researcher's strategy. The book answers nearly any question— be it instrumental, practical, or theoretical—either directly or with an appropriate reference. The matter covered, which also includes scanning TEM whenever relevant, represents a total of 40 chapters nearly equally divided into four parts.

Part I (Basics) blends topics as varied as basic geometrical optics; elastic and inelastic scattering (including every signal that may stem from the interaction of a sample with an electron beam, and how these can be tackled in practice with the electron microscope); radiation damage; a fair review of all the components that take part in the instrument ("if your own eyes were as good as our best electromagnetic lens, then you'd be legally blind!"); and the environment of the microscope including, among other items, an updated survey of electron sources, thin foil preparation, and safety instructions.

Part II is devoted to diffraction and illustrates the usefulness of this TEM feature. In addition to providing a thoughtful overview *à la* Eddington of the information available in diffraction patterns, it shows the complementarity between selected area diffraction and convergent beam electron diffraction patterns and reviews, in a clear and convincing way, the potential of CBED in crystallography. Part II also establishes the so-called Howie-Whelan equations. Regretfully though the too-often hidden method of Fresnel half-period zones is skipped; it is not quite clear either why the equivalence between the wave optical and the wave mechanical approaches is discussed before Bloch waves are formally introduced in the wave-mechanical approach. Personally I enjoyed DBW and CBC's simplified treatment of the dispersion surfaces and I appreciated the authors' efforts to produce detailed explanations and clear schematics which will show all their usefulness in Part III.

Part III (Imaging) covers all sorts of effects (mass-thickness, diffraction and phase contrast, and a number of less-frequently used imaging modes (see chapter 31) that may contribute to image contrast. Thickness and bending effects and the physics behind these are well-accounted for. Then justice is done to diffraction contrast in the tradition of the early achievements of TEM in the field of defects. A full chapter is devoted to weak-beam imaging. Of course, phase contrast (including Moiré patterns and Fresnel contrast and its applications to high resolution electron microscopy) occupies a substantial fraction of Part III. To my limited knowledge, HREM is treated comprehensively except maybe for the recently developed attempts at accounting for chemistry in the contrast. A number of concepts that had remained rather esoteric so far to nonexperts are being disclosed in such a way that beginners will not have to reinvent all the tricks and to suffer from all the artifacts. This is good news since HREM has reached a fair degree of sophistication.

Part IV (Spectrometry) addresses x-ray and energy-loss spectroscopy in nearly equal fractions. Naturally, quite an amount of space is devoted in both cases to instrumental and practical considerations; this is again essential. Quantitative x-ray energy dispersive spectroscopy is developed with special emphasis on the experimental determination of k-factors, on the importance of corrections, on spatial resolution, and minimum detectability. The presentation of energy-loss spectroscopy is remarkably simple. In addition to the information derived from the presence of ionization edges by themselves, the potential of the energy-loss near-edge structure (ELNES) and extended energy-loss fine structure (EXELFS) techniques is demonstrated and the links with a solid state physics approach of materials clearly emphasized.

In their preface DBW and CBC (check the meaning of TMBA in their lengthy list of acronyms) emphasize that they "thread two fundamental questions throughout the text. *Why* should we use a particular technique? *How* do we put the idea in practice?" This is actually what the book is about. This book provides a basic, clearcut presentation of how transmission electron microscopes should be used and of how this depends specifically on one's specific undergoing project. The authors have gracefully succeeded in providing the unseasoned reader an easy access to the information required for initiating almost any TEM-related materials science project I can think of.

DBW and CBC account very impartially for the potentials of TEM, neither exaggerating the advantages, nor minimizing the drawbacks; to the satisfaction of the instrumentally inclined reader, the authors' judgement includes the practicality and frequently the cost ("you should not waste your money buying a BSE detector!") of almost any TEM-related operation. Every TEM-related technique that was documented at the time the book went to press is addressed. A fair amount of pedagogy is involved in this endeavor. Very helpful in this respect is the authors' choice of an unusual, though savorous style—just as if Barry were sitting at the next desk. The authors should be credited for having produced such a lively document which, in my opinion, is far more accessible to the international community than would be a conventional, formal style. At the end of each chapter, references are sorted into general and specific. The selection is well-done, deliberately limited to the relatively few, essential contributions in a field where publications are annually by the thousands. A practical inconvenience in the four-volumes version of this book, which can well be corrected in a future edition, is the lack of lists of acronyms and symbols, and the absence of a Table of Contents other than in volume I.

Last but not least—in spite of its encyclopedic nature, of the profusion of illustrations including a number of fairly well reproduced micrographs, and of its agreeable presentation—the book is cheap. This makes the information accessible by the less-favored within the worldwide materials science community, a not so frequent option in the market of scientific edition.

***Reviewer:** Patrick Veyssière is a materials scientist and director of the Laboratory for Microstructural Studies, a research group located near Paris, cosponsored by the National Center for Scientific Research (CNRS) and the National Agency for Space and Aircraft Studies (ONERA). His primary research interest is in relating specific plastic behaviors, such as flow stress anomalies in intermetallic alloys, to properties taking place in the cores of dislocations.*

UV Lasers: Effects and Applications in Materials Science

W.W. Duley
(Cambridge University Press, New York, 1996)
407 pages, $95.00
ISBN 0-521-46498-6

The applications of lasers have been established in many aspects of modern-day life from engineering such as welding, cutting and surface treatment, metrology, chemistry, physics, and medicine. Over the last 20 years the main drive was in the development of CO_2 and NdYAG lasers and applications. In his book, Walter Duley has described the development of the longer wavelength lasers. Interesting is the rapid development of the possible specific applications of ultraviolet (uv) lasers resulting from experience with CO_2 and NdYAG lasers.

The book is divided into nine chapters covering the topics of short-wave lasers, optical properties of materials at uv wavelengths, photochemical and photothermal effects, interaction of uv radiation with materials, interaction of uv radiation with organic polymers, interactions and materials removal in inorganic insulators, uv laser preparation and etching of superconductors, interactions and effects in semiconductors, and laser deposition.

The first chapter provides a historical survey of the development of short wavelength lasers culminating in the rare gas halide lasers (RGH). RGH lasers were discussed in some detail. There are only a few choices for highly transmissive optical materials at wavelengths less than 250 mm. These are in general wide bandgap oxide and fluorides of which the most important are listed. Optics for microstructure generation are also discussed.

The second chapter deals with optical properties of materials at uv wavelengths, in particular refractive index and absorptivities of metals, semiconductors, carbons, and polymers at wavelengths 308, 248, and 193 mm. The chapter concludes with a treatment of the optical properties of small particles and their films, heterogeneous systems (conductors in an insulating material), and liquids.

The remainder of the book is dedicated to effects, and thus possible applications and limitations of short-wavelength lasers. The uv sources can initiate both photochemical and photothermal effects in condensed matter, which is treated in chapter three in a general manner. Thereafter, the interaction with specific materials is considered in depth, leading to applications such as treatment of metals, laser-assisted etching, corrosion treatment, and ablation. Similarly, for polymers, ablation and lithography are discussed. Numerous applications are available for inorganic insulators, defect formation, laser sputtering, and laser-assisted chemical etching and formation of Bragg gratings in optical fibers. Some applications of excimer laser have become very well-known, which are treated in the last three chapters. Preparation and etching of a range of high-temperature superconductors on various substrates has been developed. The process involves stoichiometric deposition and is the subject of considerable interest, aspects of which are also discussed in the last chapter.

Yet another fascinating chapter is the description of the treatment of semiconductors limits with, in particular, laser sputtering, laser-induced chemical etching, laser-assisted doping, laser annealing, and amorphization.

Laser deposition can be carried out by various routes, photothermal as well as photochemical. Both routes are discussed in detail and compared with other methods. An impressive list of materials so deposited underlines the importance of the uv techniques.

The book is well-written, concentrating on an understanding of the basic mechanisms, thus providing excellent chapters of applications. The book will be useful not only to students and researchers in the field of lasers, but also physicists and engineers active in other fields.

References are provided at the end of each chapter. Although not extensive, they will provide an invaluable asset as an introduction to the subject.

***Reviewer:** B.L. Mordike is a professor of materials technology at the Technical University Clausthal in Germany. His current research interests include laser treatment of materials, in particular surface modification—transformation hardening, remelting, cladding, and texturing.*